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The present investigation was made on spectrometric auroral data obtained on the dayside and nightside of the auroral oval in Svalbard. Synthetic spectra of O_2^+ 1NG and N_2^+ 1NG bands were calculated. The transition probabilities were obtained by particular solutions of the Schrodinger equation. The synthetic spectra were used to analyse the auroral spectrum from 5200 to 5800 Å, deriving the intensities of all the auroral emissions of this spectral region.

The same spectral technique was used to analyse solar spectra, deriving ozone column densities and spectral UV irradiances.

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This report has been reviewed and is releasable to the National Technical Information Service (NTIS). At NTIS it will be releasable to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

OWEN R. COTE'
Chief, Chief, Geophysics and Space

FRED T. GILLIAM, Lt Col, USAF
Chief Scientist

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Final Scientific Report
30 Sep 87 - 29 Sep 88

By the AFOSR-86-0327 grant we have been able to analyze our optical data from Svalbard. We have shown that the optical spectra can be precisely reproduced by synthetic spectra, where the transition probabilities have been obtained from particular solutions of the Schrödinger equation.

This method has been used on measurements of the N_2^+ and O_2^+ first negative bands, absolute temperatures and intensity ratios. Neutral temperature variations in the auroral E-region are difficult to obtain, but we have published an able method. Since both the O_2^+ and N_2^+ mainly originate in the E-region, the rotational distribution of these bands will indicate temperature variations. Intensity ratios of these band systems will point out height variations of the centroid of the emission layer since the density of N_2 and O_2 varies through the E-layer. However, a better estimate of the height could be obtained by triangulation measurements using two ground-based instruments situated about 100 km apart along a geomagnetic meridian. Then the whole auroral height profile would be found.

Curious enough, no optical measurements have ever shown a temperature increase of the neutral atmosphere in the E-region associated with an auroral substorm. The same result is obtained in our work, and we argue that it is due to the high heat capacity of the E-region and rapid transport processes.

The findings of this analysis are published in two papers:

K. Henriksen and L. Veseth: Analysis of auroral O_2^+ first negative bands. Can. J. Phys. 65, 1119-1132, 1987.

K. Henriksen, L. Veseth, C.S. Deehr and R.W. Smith: Neutral temperatures and emission height changes in an E-region aurora. Planet. Space Sci. 35, 1317-1321, 1987.

During the auroral season 1986/87 cooperative studies with Dr. W. Pendelton's group, Utah State University, were carried out

in Svalbard. They measured with a Michelson Interferometer the spectral region from 9000 to 15000 Å. In this spectral region the N_2^+ Meinel (0,0) band and the distinguished HeI line 10830 Å appear. Preliminary results indicate that the N_2^+ M (0,0) band is selectively enhanced in F-region aurora by energy transfer from O^+ ions. The Meinel bands which we measure by spectrometer in the near infrared, are not enhanced. This phenomenon is detectable only in cusp and polar cap aurora.

Helium precipitation seems to occur intermittently in bright auroras, and the intensity enhancement of the 10830 Å line can be 2-3 times the geocoronal background.

During the period 1987-88 Dr. C.S. Gardner, University of Illinois at Urbana - Champaign, had a dimer laser in Svalbard to study the structure of the mesospheric sodium layer, gravity waves and how they were affected by geomagnetic and auroral activity. Primary results indicate that the sodium layer almost disappears during summer months, but influence from geomagnetic activity is harder to see. Analysis in under way.

The analysis programs developed under this grant will be used in future auroral and optical cooperative projects with American groups visiting Svalbard. Our station, Nordlys-stasjonen, will be extended by funds from National Science Foundation, and it is proposed to be a main station for the CEDAR program.

The spectrometric analysis technique is also usable for studies of solar irradiance and ozone. We have developed spectrometric instruments capable of measuring the solar irradiance from 2800 to 8000 Å, and used it in Tromsø and Svalbard. The media and news are filled with predictions and hints about decreasing stratospheric ozone and increasing UVB irradiance. Here we have developed a method for simultaneously measuring both UV irradiance and the ozone column density. We find that both quantities have the expected values, and we don't find any published measurement showing that the global ozone layer is in danger. However, the frightening theories are supported by Nimbus 7 SBUV measurement, but they are wrong due to the decreasing sensitivity of the SBUV instrument. Our first results are accepted for publication in Atmospheric Environment:

K. Henriksen, K. Stamnes and P. Østensen: Measurements of solar UV, visible and near IR irradiance at 78^0N, 1988.

Manuscript included. The referees comment that the manuscript gives the first results in a very important measurement program, and we will of course continue.

The Auroral Observatory
2 Jan 1989

Kjell Henriksen